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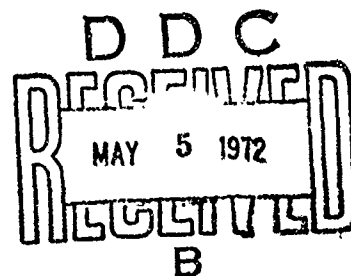
**AN EVALUATION OF THE APPLICANT INTERVIEW FORM  
FOR CNA SUPPORT JOBS**

**Robert F. Lockman**

**Professional Paper No. 88**

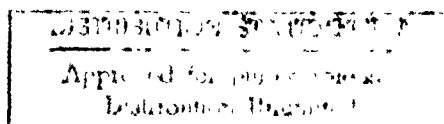
**March 1972**

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AN EVALUATION OF THE APPLICANT INTERVIEW FORM FOR CNA  
SUPPORT JOBS

Robert F. Lockman\*

\*This study was requested by Mr. William F. O'Keefe, Director of Administration for CNA. I am indebted to him for his cooperation in providing the necessary data. I am also indebted to Dr. Peter H. Stoloff for his programming services and his helpful critique of the paper.

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#### SUMMARY AND RECOMMENDATIONS

Ratings on the Interview Evaluation Form used with applicants for CNA support jobs are highly consistent within sets of interviewers, but unreliable between sets of interviewers. Their validity for predicting later job performance is modest at best.

A more structured interview evaluation form should be sought, and several interviewers trained to use it. This will insure more standardized treatment of applicants and useful data for future reliability and validity evaluation.

## PURPOSE

The Interview Evaluation Form shown on the next page has been used with applicants for CNA support positions. It contains 10 items on specific background characteristics and interview behaviors that are rated on a scale ranging from superior through unacceptable. Another item is used to evaluate the applicant on the degree to which he or she meets the requirements of the position, and a final item is the interviewer's recommendation to hire, hold, or reject the applicant.

Since an interviewer can influence an applicant's behavior, it is important to know if the interviewer's behavior differs from applicant to applicant and if interviewers differ from each other. Therefore, we will try to evaluate both interviewer consistency and the agreement between interviewers, or reliability. Finally we will evaluate the relationship between interviewer ratings and later performance ratings, or validity.

In general, the literature shows that both the reliability and validity of interview data vary widely (Blum and Naylor, 1968, pp. 153-154). Thus, it is important that we evaluate the important features of consistency, reliability, and validity with the data at hand and to the extent possible.

# INTERVIEW EVALUATION FORM

Applicant's Name

Position

Interviewer

Date

The applicant's

1. personal impression.
2. self-confidence.
3. common sense.
4. adaptability and flexibility.
5. ability to communicate.
6. answers to questions.
7. work experience and/or educational training relative to the position.
8. reasons for past changes in employment.
9. enthusiasm and interest.
10. skills that are required by the particular position.

| 3<br>Superior | 2<br>Acceptable | 1<br>Unacceptable |
|---------------|-----------------|-------------------|
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |
|               |                 |                   |

General Comments (include specific strengths and weaknesses):

|                      |                            |                                    |
|----------------------|----------------------------|------------------------------------|
| 3                    | 2                          | 1                                  |
| Exceeds Requirements | Meets Minimum Requirements | Does Not Meet Minimum Requirements |

Recommendations:

☒ 3 Make offer subject to reference checks.

☐ 1 Reject.

☐ 2 Hold for future reference.

## APPLICANTS AND DATA

There were 37 applicants interviewed from January 1970 through March 1971 for whom interview and performance evaluation data were available. The variability of the ratings is less than would be expected, since rejected applicants were not included.

The interview ratings were coded 3, 2, and 1 as shown on the form. Although this restricts somewhat the variation in the original ratings, it clearly demarcates the limits or areas of the marks along the scales.

Below is a table of the available ratings and other data:

### 1. Interview Evaluation Form:

| <u>Number of interviewers<br/>per applicant</u> | <u>Number of applicants</u> | <u>Number of interviews</u> |
|---|-----------------------------|-----------------------------|
| 1   | 7                           | 7                           |
| 2   | 14                          | 28                          |
| 3   | <u>16</u>                   | <u>48</u>                   |
|   | 37                          | 83                          |

### 2. Rating Set

| <u>N</u>  | <u>Items 1-11</u> |             | <u>Item 12</u> |             |
|-----------|-------------------|-------------|----------------|-------------|
|           | <u>Mean</u>       | <u>S.D.</u> | <u>Mean</u>    | <u>S.D.</u> |
| 37        | 2.5               | .5          | 2.9            | .3          |
| 30        | 2.5               | .6          | 2.9            | .4          |
| 16        | 2.5               | .5          | 2.9            | .3          |
| <u>83</u> |                   |             |                |             |

### 3. Performance rating (sum of 10 separate ratings) after 6 months of employment: Mean of 38, Standard Deviation of 7.



4. Sex: 26 women and 11 men

5. Selection tests:

|           | <u>N</u>          | <u>Mean</u> | <u>Standard deviation</u> |
|-----------|-------------------|-------------|---------------------------|
| Verbal    | 35                | 32          | 11                        |
| Clerical  | 33                | 32          | 5                         |
| Numerical | 34                | 32          | 11                        |
| Typing    | 22 (all<br>women) | 55          | 17                        |

It is important to note that the first (or second or third) set of ratings was not necessarily made by the same interviewers. This will cause some problems in interpreting the results. However, the means and standard deviations of items 1-11 were very similar for all three sets of ratings, as were these same statistics for item 12, the hiring recommendation.

The ratings on the first 11 items average midway between superior and acceptable, and two-thirds of them fall within this range. Ratings on item 12, the hiring recommendation, average just below the top of the superior category and vary even less. Had rejected applicants been included in the sample, the means would have been lower and the variabilities higher. However, 6-month performance evaluations would not have been available for rejects, and one of our purposes is to determine the validity of the interview ratings for predicting performance.

The mean and standard deviation of the performance rating (actually a sum of ratings on 10 items) are very close to those of a sample of 114 CNA support employees used earlier in a validation of CNA selection

tests (Lockman, 1971), so the present sample is not atypical insofar as performance is concerned.

The Verbal and Numerical selection tests for our sample are also very similar in mean and standard deviation to those of the sample of CNA support employees. However, our applicant sample has a mean 8 points lower and a standard deviation 10 points less than the larger sample.

## ANALYSES

Two statistical techniques were used to evaluate the reliability of the interview items across the first, second, and third sets of ratings: product-moment correlation coefficients were computed for each pair of ratings for each item, and Ebel's estimate of rating reliability was computed for each item (Ebel, 1951). (The latter is an intraclass correlation coefficient calculated by an analysis of variance of the ratings. In our case, only two components of the variance, attributable to applicants and error, were separated. The variance between raters was included in the error term because in practice decisions are made by comparing the ratings assigned to different applicants by different interviewers-the procedure recommended by Ebel under these circumstances.)

A principal components analysis of the 12 ratings was made to see how many different kinds of characteristic or factors were really being measured (Nunnally, 1967, chap. 9). We expected that 12 distinct kinds were not being measured, and that many of the items would correlate highly with one another. If this is true, we can reduce the ratings to fewer factors composed of similar but independent groups of items.

Finally, product-moment correlation coefficients were computed between the various ratings, rating factors, sex, and the selection test scores, on the one hand, and the performance rating, on the other hand. This provides us with an indication of the predictive validities of the rating and other selection variables.

## RESULTS

### Reliability

The table below shows the mean correlations of the available pairs of ratings for each item, along with the Ebel reliability estimate.

| <u>Items</u> | <u>Mean<br/>r</u> | <u>Ebel<br/><math>r^2_{xx}</math></u> |
|--------------|-------------------|---------------------------------------|
| 1            | .34               | .30                                   |
| 2            | .27               | .24                                   |
| 3            | .35               | .31                                   |
| 4            | .37               | .27                                   |
| 5            | .28               | .17                                   |
| 6            | .41               | .26                                   |
| 7            | .42               | .39                                   |
| 8            | .23               | .24                                   |
| 9            | .29               | .29                                   |
| 10           | .42               | .44                                   |
| 11           | .27               | .24                                   |
| <u>12</u>    | <u>.21</u>        | <u>.21</u>                            |
| Median       | .32               | .28                                   |

The median of the 36 pairs of correlations is .32 compared with the median Ebel coefficient of .28. In fact, the rank-order correlation between the mean correlations and Ebel coefficients is .81. The striking feature of these statistics is their low magnitude, due mainly to the small variation in the ratings to begin with.

If we look at the mean correlations between pairs of ratings, we find a similar picture:

| <u>Ratings of the<br/>same applicant</u> | <u>Number of<br/>applicants</u> | <u>Mean<br/>r</u> | <u>Range of r</u> |
|--|---------------------------------|-------------------|-------------------|
| 1st with 2nd                             | 30                              | .26               | .47 to .05        |
| 1st with 3rd                             | 16                              | .42               | .63 to .22        |
| 2nd with 3rd                             | 16                              | .28               | .71 to -.10       |

It appears, then, that rater agreement or between-rater reliability is not very high, but again the small variation of the ratings is a major cause.

If we look at the percentage of perfect agreements in ratings on item 12, the hiring recommendation, we get a different picture (chance in this case would be 33 percent):

|                      |             |
|----------------------|-------------|
| 1st with 2nd ratings | 26/30 = 82% |
| 1st with 3rd ratings | 14/16 = 82% |
| 2nd with 3rd ratings | 13/16 = 81% |

This kind of analysis was not carried out on the other 11 items for two reasons: the means and standard deviations of the ratings were very similar, and the factor analysis of the 12 items showed that the first 11 were measuring the same thing to about the same degree. Their average intercorrelation was .62 and their loadings or correlations with the general factor ranged from .70 to .90, as shown below (Note that the hiring recommendation does not relate to this factor):

| <u>Item</u>                   | <u>Loading</u> |
|-------------------------------|----------------|
| 1. Personal impression        | .92            |
| 2. Self-confidence            | .77            |
| 3. Common sense               | .84            |
| 4. Adaptability               | .88            |
| 5. Ability to communicate     | .83            |
| 6. Answers                    | .82            |
| 7. Experience/training        | .70            |
| 8. Reasons for changes        | .71            |
| 9. Enthusiasm                 | .73            |
| 10. Relevant skills           | .77            |
| 11. Degree meets requirements | .80            |
| 12. Hiring recommendation     | .23            |
| Percent of trace              | 75             |

Next we looked at the means and standard deviations of the three sets of summed ratings across items 1-10 and the average of them. The results follow:

| <u>Rating Set</u> | <u>N</u> | <u>Mean of Items 1-10</u> |              | <u>S.D. of items 1-10</u> |              |
|-------------------|----------|---------------------------|--------------|---------------------------|--------------|
|                   |          | <u>Mean</u>               | <u>Range</u> | <u>Mean</u>               | <u>Range</u> |
| 1                 | 37       | 2.54                      | 2.62 to 2.32 | .53                       | .61 to .49   |
| 2                 | 30       | 2.52                      | 2.62 to 2.41 | .57                       | .63 to .56   |
| 3                 | 16       | 2.51                      | 2.69 to 2.33 | .51                       | .62 to .48   |
| Average           | 37       | 2.52                      | 2.59 to 2.39 | .43                       | .49 to .40   |

There is little variation either within or between the three sets of ratings for the first 10 items. (We did not include item 11 here, since it was rated on a different scale than the first 10 items; rather, item 11 and item 12, the hiring recommendation, will be used separately.)

Because the first 10 items were measuring the same thing and because their standard deviations were very similar, we summed them for each applicant to produce a composite in which the items were weighted as a function of their standard deviation, about equally. We called this composite "Overall Interviewer Impression." In theory, its reliability should be higher than any of its item parts. To determine if this was so, we treated each set of ratings as item samples whose reliability will depend entirely on the average correlation among the items and the number of items (Nunnally 1967, p. 194).<sup>\*</sup> The pertinent results are shown below:

| <u>Rating set</u> | <u>N</u> | <u><math>\bar{r}</math></u> | <u>Internal<br/>reliability</u> |
|-------------------|----------|-----------------------------|---------------------------------|
| 1                 | 37       | .61                         | .94                             |
| 2                 | 30       | .62                         | .94                             |
| 3                 | 16       | .52                         | .94                             |

From these results, we conclude that the composite or sum of ratings on interview items 1 through 10 has a high degree of internal reliability. This does not imply that the composite ratings necessarily agree highly with one another, only that they are internally consistent or homogeneous--another way of saying they measure the same thing.

$$* r_{kk} = \frac{k \bar{r}}{1 + (k-1)\bar{r}}$$

where k is the number of items and  $\bar{r}$  is their mean intercorrelation.

We eliminated the third set of ratings because they were based on only 16 applicants. The correlation of the composite between sets one and two is .37 - indicating that the overall agreement (or between-rate reliability) is still rather low, albeit higher than the average of the individual items. Although the sets of ratings are highly consistent, reliability between sets of ratings is moderate at best. This may in part be due to the fact that more than one rater was involved in each set of ratings. Because of unreliability, we can expect different correlations among the rating composite, selection tests, recommendations, and performance ratings for the two sets of ratings. Further, the obtained correlations will be limited in size by the low reliability.

#### Validity

Now, we turn to the question of the validity of the composite ratings, selection test scores, and sex for predicting performance ratings six months after the applicants were hired. The table below contains the intercorrelations of these variables for the first and second sets of ratings and their average. (The correlations among sex, test scores, and performance are shown under the dashed line in the table. They are not affected by the ratings or by differences among raters.)



1st Rating Set

| Correlations (N = 37)         |             |             |            |          |          |          |          |              |          |
|-------------------------------|-------------|-------------|------------|----------|----------|----------|----------|--------------|----------|
|                               | <u>Req.</u> | <u>Rec.</u> | <u>Sex</u> | <u>V</u> | <u>C</u> | <u>N</u> | <u>T</u> | <u>Perf.</u> | <u>r</u> |
| Composite rating (items 1-10) | .53         | .21         | .62        | .29      | .43      | .18      | .28      | .20          | .20      |
| Requirement (item 11)         |             | .12         | .35        | .34      | .04      | .19      | -.08     | .10          |          |
| Recommendation (item 12)      |             |             | -.19       | -.06     | .05      | -.05     | .12      | .02          |          |

2nd Rating Set

| Correlations (N = 30) |             |             |            |          |          |          |          |              |          |
|-----------------------|-------------|-------------|------------|----------|----------|----------|----------|--------------|----------|
|                       | <u>Req.</u> | <u>Rec.</u> | <u>Sex</u> | <u>V</u> | <u>C</u> | <u>N</u> | <u>T</u> | <u>Perf.</u> | <u>r</u> |
| Composite rating      | .78         | .00         | .51        | .29      | .31      | .44      | .38      | .30          | .10      |
| Requirement           |             | .15         | .50        | .50      | .25      | .45      | .14      | .25          |          |
| Recommendation        |             |             | -.01       | -.08     | .28      | .11      | .05      | .31          |          |

Average of 1st and 2nd Rating Sets

| Mean Correlations |             |             |            |          |          |          |          |              |  |
|-------------------|-------------|-------------|------------|----------|----------|----------|----------|--------------|--|
|                   | <u>Req.</u> | <u>Rec.</u> | <u>Sex</u> | <u>V</u> | <u>C</u> | <u>N</u> | <u>T</u> | <u>Perf.</u> |  |
| Composite rating  | .68         | .10         | .56        | .28      | .37      | .31      | .33      | .24          |  |
| Requirement       |             | .14         | .43        | .42      | .15      | .33      | .03      | .18          |  |
| Recommendation    |             |             | -.10       | -.07     | .17      | .03      | .09      | .17          |  |
| -----             |             |             |            |          |          |          |          |              |  |
| Sex               |             |             |            | .58      | .51      | .29      | *        | .28          |  |
| Verbal Test       |             |             |            |          | .21      | .22      | -.15     | .22          |  |
| Clerical Test     |             |             |            |          |          | .30      | .26      | .09          |  |
| Numerical Test    |             |             |            |          |          |          | .16      | .12          |  |
| Typing Test       |             |             |            |          |          |          |          | .00          |  |

\*Only women took the typing test

We expected differences in the correlations among the interview ratings variables for sets one and two, but there are similarities beyond those that could be expected by chance. Looking at the averaged correlations, we find the following:

1. Composite rating correlates .68 with the rating on the degree to which the applicant meets the requirements of the job for which he or she is applying. This is logical if we view the requirements rating as an overall assessment of the applicant's suitability that should relate to the ratings of background characteristics and behavior in the interview. We have also shown that item 11 loads highly on the general factor measured also by items 1 through 10.
2. Composite rating correlates .56 with sex, indicating that women are rated higher than men - perhaps a defensible bias if the job openings are viewed by interviewers as more suitable for women than men. The requirement rating also correlates with sex, .43.
3. Sex correlates .42 with scores on the Verbal aptitude test. Past research has shown that women score higher than men on this test.
4. Sex correlates .28 with performance rating ( $p = .10$ ), a small relationship that has been found before.
5. Composite rating correlates .24 with performance rating (compound  $p = .10$ ). This is a small relationship or validity, but the sample of applicants is not large, the

range of the interview ratings is limited, and the between-rater reliability is low, so it is perhaps about all we could expect.

It is interesting to note that of all the variables, only sex and composite rating correlate significantly with performance in this sample, and that they also correlate highly with one another.

6. The hiring recommendation item does not correlate with any of the other variables, including performance. It is the least reliable of all 12 ratings, with both an average correlation and Ebel reliability of .21. It is also limited in range, since no applicant was rejected.

## CONCLUSIONS

1. The 12 items on the Interview Evaluation Form for CNA support personnel have low individual reliabilities (averaging around .30).
2. The first 10 of these items, ratings of the applicant's background and interview behavior, all measure the same thing or factor to about the same degree. This general factor was called "Overall Interviewer Impression" and can be obtained simply by summing the ratings for these items.
3. The sum of these 10 ratings has a very high degree of internal consistency (.94), but a very modest degree of reliability between sets of ratings (.37) - albeit somewhat higher than that of the average item ratings.
4. The sum of the 10 ratings correlates fairly highly with sex (.56) in favor of women.
5. Both the sum of the 10 ratings and sex have significant correlations with performance ratings after six months on the job, but the practical value of these relationships is low.

REFERENCES

Blum, Milton L. and Naylor, James C., Industrial Psychology. New York: Harper and Row, 1968.

Ebel, Robert L., Estimation of the Reliability of Ratings. Psychometrika, 16, (4), December 1951.

Lockman, Robert F., Analyses of Selection and Performance Measures for CNA Support Personnel. Professional Paper No. 63, Center for Naval Analyses, February 1971.

Nunnally, Jum C., Psychometric Theory. New York: McGraw-Hill, 1967.

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\*Mathematical Institute, University of St. Andrew

PP 40

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CNA Professional Papers — Con'd.

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\*Mathematical Institute, University of St. Andrew

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CNA Professional Papers - Cont'd.

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Utgoff, Victor A. and Kashyap, R. L.\*, "On Behavior Strategy Solutions in Two-Person Zero-Sum Finite Extended Games with Imperfect Information," 37 pp., Feb 1971, (Accepted for publication in the SIAM Journal on Applied Mathematics) AD 720 361

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Kadane, Joseph B. and Iversen, Gudmund R.\*, "Estimation of Multinomial Process When Only the Sum and the Number Governed by Each Process is Observed," 13 pp., Apr 1971, AD 722 382

\*University of Michigan

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\*School of Electrical Engineering, Purdue University

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Brown, Jr. George F.; Silverman, Lester P. and Perlman, Bernard L. (AWF3), "Optimal Positioning of Inventory Stock in a Multi-Echelon System," 37 pp., May 1971, (Presented at the 39th Annual Meeting of the Operations Research Society of America, May 1971) AD 723 852

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